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News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Building 101, Room E215, Gaithersburg, MD 20899-2500; telephone: (301) 975-3577.

BURNING MATTRESSES YIELD A SAFER NIGHT'S SLEEP FOR ALL

Bedroom fires typically begin with the flaming ignition, not of the bed, but of the bed coverings. Fatalities occur after flashover, when all combustibles in a room burst into flames and the fire spreads rapidly.

NIST engineers have developed a technique for testing the threat to a mattress from burning bed coverings such as sheets, blankets and comforters. The testing advance completes the first phase of a program, supported by the Sleep Products Safety Council, aimed at reducing hazards associated with the open-flame ignition of residential mattresses. All mattresses sold in the United States since 1973 are already resistant to ignition by cigarettes.

To quantify the intensity of a fire that a mattress might experience, the researchers burned 12 different combinations of bed coverings. They developed a unique infrared imaging technique to follow the spread of flames and heat intensity on camera and used the NIST-devised technique of oxygen consumption calorimetry to measure the rate of heat release. With the results, they created a two-propane burner device that simulates the shape and intensity of a bed covering fire. This was used on four experimental mattress/boxspring designs with a variety of fire-retardant features to determine how well the burner-initiated fires mirrored real ones.

Further research is under way to ascertain what reduction of fire losses, in terms of reduced fatalities, injuries and property damage, can be expected from bed assemblies that achieve reduced rate of heat release. A major goal is to develop a standard test for manufacturers to measure the fire performance of different mattress/boxspring designs and component combinations in a bed covering-ignited fire.

A single copy of the report on this research, *Flammability Assessment Methodology for Mattresses* (NISTIR 6497), is available from NIST Public Inquiries by fax at (301) 926-1630 or electronic mail at inquiries@nist.gov.

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NIST CAN HELP YOUR COMPUTER SPEAK FLUENT XML

An Internet language called XML is rapidly becoming one of the most popular languages in the world.

Incorporated into many Internet web pages—particularly those involved in electronic commerce—XML is a language that describes information in a way that allows computers to exchange information and automatically act on it. Consequently, it can speed up automation of certain processes.

NIST computer scientists recently completed a major expansion of software tests that allow people to make sure that their XML systems conform to voluntary industry standards. This lets people check their systems to ensure they can communicate flawlessly with other systems that use XML. In addition to the XML tests, NIST computer scientists have released software tests for the Document Object Model. The DOM is an application programming interface for XML and HTML that lets people or computers dynamically access and update web pages.

NIST teamed up with OASIS, an industry consortium, to expand and refine the XML conformance testing program. OASIS members include many of the nation's leading computer hardware and software companies.

The XML Conformance Test Suite and a companion test suite for DOM contains more than 4,000 test files. It can be downloaded from the World Wide Web at www.nist.gov/xml/.
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WORKSHOP SEEKS MORE OPEN EUROPEAN MARKET FOR LAB, DIAGNOSTIC TESTS

NIST hosted a workshop in November 2000, to address a potential non-tariff trade barrier for U.S. medical diagnostic devices in the European Union. The workshop, "Measurement Traceability for Clinical Laboratory Testing and In Vitro Diagnostic Test Systems," was geared for members of the medical diagnostics industry, professional organizations, government, and national and international standards developing organizations.

A new EU directive on in vitro diagnostics will require that calibration of all new medical diagnostic devices be traceable to "standards of a higher order" by 2003. Existing diagnostic products, without the EU stamp of approval, can remain on the market only until 2005. Although NIST produces many reference materials for medical tests, the United States currently does not have a formalized system for tracing the accuracy of all tests performed with in vitro diagnostic devices and systems. U.S. manufacturers, who produce over 60 % of the devices sold in Europe, potentially could have their products challenged on the basis of this directive.

The 2 day workshop was held at NIST, Gaithersburg, MD. It is co-sponsored by NIST, the American Association for Clinical Chemistry, the Centers for Disease Control and Prevention, the Health Industry Manufacturers Association and the National Committee for Clinical Laboratory Standards.
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WHAT'S THE BUZZ? NEW BEES BUILD BETTER BUILDINGS

BEES (Building for Environmental and Economic Sustainability) 2.0, an updated, expanded version of the powerful NIST software designed to help the construction industry select cost-effective "green" building products, is available for free download over the Internet. It offers comparative environmental and economic performance data for 65 building products, more than twice the number of the earlier version.

The software evaluates generic products for framing, exterior and interior wall finishes, wall and roof sheathing, ceiling and wall insulation, roof and floor coverings, slabs, basement walls, beams, columns, parking lot paving and driveways. With BEES 2.0, designers, builders and manufacturers now can contrast competing products' impacts on global warming, acidication, eutrophication, indoor air quality, resource depletion, solid waste, ecological toxicity, human toxicity, ozone depletion and smog. BEES 2.0 measures the environmental performance of each product by using a life-cycle assessment approach. All stages in the life of a product are consideredraw material acquisition, manufacture, transportation, installation, use, and recycling and waste management.

BEES 2.0's economic assessment of a product takes into consideration the costs of initial investment, replacement, operation, maintenance and repair, and disposal. Environmental and economic performance are combined into an overall performance measure.The developers of BEES 2.0 plan to update the software every 12 to 18 months.

BEES 2.0 runs on a Windows 95, 98, 2000, or NT personal computer with 486 or higher microprocessor, 32 megbytes or more of RAM, and at least 31 megabytes of available disk space. A printer must be installed. BEES 2.0 can be downloaded from the Internet at www.bfrl.nist.gov/oae/bees.html. A compact disc and printed manual are available from the EPA Pollution Prevention Information Clearinghouse by calling (202) 260-1023 or e-mailing ppic@epamail.epa.gov.
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USING FERROELECTRIC MATERIALS FOR MICROWAVE ELECTRONICS

Thin-film ferroelectric materials have received considerable attention because of their growing use in electronic, electro-optic, optical and acoustic devices. Potential applications include random access memories, pyroelectric detectors, acoustic transducers and microwave devices.

An important characteristic of these materials is the ability to change their dielectric constants by an externally applied electric field. This idea is being pursued in a class of novel high-temperature-superconducting tunable microwave devices such as microstrip line phase shifters, high-Q resonators and tunable filters. Of the various ferroelectric materials, perovskite oxide thin films are considered potential candidates for tunable microwave devices because of their high dielectric constant.

As part of its program on new non-linear dielectric films, scientists from NIST and the University of Colorado at Boulder have investigated perovskite oxide thin films for cryogenic and ambient temperature

applications. In a recent technical paper, they discuss film growth as well as the structural and low- frequency dielectric properties of the films. They also present dielectric data obtained on some bulk samples and, in order to understand the effect of strain on dielectric properties, present results on high-resolution x-ray diffraction studies on some of the films.

Copies of paper no. 32-00, "A Tunable, Low-Loss Epitaxial Oxide Films for Microwave Electronics," are available from Sarabeth Harris, MC104, NIST, Boulder, CO 80305-3337; (303) 497-3237; sarabeth@boulder.nist.gov.

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SEPTEMBER SYMPOSIUM PLANS (OPTICAL) FIBER-RICH MENU

A Symposium on Optical Fiber Measure-ments was held in September 2000, in Boulder, CO, devoted to measurements on fibers, integrated optics, components and systems. This biennial symposium is sponsored by NIST in cooperation with the IEEE Lasers and Electro-Optics Society and the Optical Society of America.

The symposium consists entirely of experimental and analytical papers on all measurement aspects of guided lightwave technology. Attendees focused on measurements on optical fiber telecommunications, sensors, fiber lasers/amplifiers, integrated optics, planar waveguides, photonic crystals, switches, couplers, systems (long haul, LANs/subscriber loops, WDM and TDM), standards, and field and laboratory instrumentation. The types of measurements discussed included attenuation/loss, chromatic dispersion, cross talk, cutoff wavelength, effective area, effective index, four-wave mixing efficiency, index of refraction profile, mode-field diameter, non-linear coefficients, polarization dependent loss and polarization-mode dispersion.

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NEW SOFTWARE MAINSTREAMS AIR QUALITY DESIGN INNOVATION

A recent Department of Energy study links poor indoor environmental conditions to significant rates of respiratory disease, sick building symptoms and reduced worker productivity. Estimates of potential annual savings and productivity improvements resulting from innovations in ventilation system design and operation range from $20 billion to more than $100 billion. As a catalyst for such advances, NIST has just released a Windows™ version of CONTAMW 1.0, its computer simulation program for multizone airflow and indoor air quality analysis.

CONTAMW 1.0 can be used to determine a building's infiltration, exfiltration and room-to-room airflow rates, as well as calculate the dispersal of airborne contaminants. It also is capable of predicting, for eventual risk assessment, the exposure of building occupants to the airborne contaminants. The software's ability to predict contaminant concentrations enables users to preview the ventilation and indoor air quality performance of buildings before they are constructed or occupied.

Engineers used an earlier DOS version of the software to evaluate ventilation systems at the Savannah River Nuclear Laboratory, as well as potential smoke movement and other fire safety issues related to planned renovations of New York's World Trade Center. The new, more easily operated program—which includes a Windows™—graphical user interface is expected to increase usage by architects; builders; heating, ventilating, and air-conditioning operators; maintenance engineers; and researchers.

For technical information, contact Stuart Dols, (301) 975-5860, stuart.dols@nist.gov. CONTAMW 1.0 may be downloaded from the World Wide Web at www.brfrl.nist.gov/863/contam. A CONTAMW web site will be online by the end of the year.

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BIOMETRIC CONFERENCE TO ID MAJOR ISSUES, ADVANCES

Biometrics are automated methods of recognizing a person based on physiological or behavioral characteristics. Law enforcement agencies have used traditional biometrics such as fingerprints for decades. Modern biometrics offer an expanding set of recognition technologies, including hand geometry, iris structure, voice identification, facial characteristics and even vein patterns on the back of one's hands. Systems incorporating these new biometrics are in use or being tested in many places where identification and restricted access are important—for example, hospital nurseries, airports, border crossings and laboratories.

Biometrics also will play an increasing role in electronic commerce by adding security measures beyond encryption and digital signatures.

NIST hosted the Biometric Consortium's annual fall conference to examine technological issues facing the emerging biometrics industry and showcase recent advances in the field. It also explored new developments in the areas of metrology, assurance and standards, as well as addressing biometrics integration with information technology products such as smart cards. The meeting was held at NIST in Gaithersburg, MD, in

September 2000. An introductory seminar for newcomers to the technology was offered on the first day of the conference.

The Biometric Consortium serves as the government's focal point for research, development, test, evaluation, and application of biometric-based personal identification and verification technology. It currently has over 700 members from private industry, federal/state/local governments and academia.

For technical information, contact Fernando Podio, (301) 975-2947, fernando.podio@nist.gov. Information on the Biometric Consortium may be found at http//www.biometrics.org.
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TAKING THE TEMPERATURE OF RAPID THERMAL PROCESSING (RTP) SYSTEMS

How hot is it? Like weather watchers, semiconductor manufacturers want to know the answer to this question, especially for their rapid thermal processing systems. To reach the quality and device-performance requirements set for next-generation integrated circuits, chipmakers say they need a threefold improvement in their ability to measure and control temperature during single-wafer processing.

A new, NIST-patented calibration wafer promises to deliver the desired level of accuracy. Just as significant, the wafer—instrumented with thin-film thermocouples—can link temperature measurements to the international temperature scale. This will make it easier to replicate processing conditions in different RTP chambers and at different facilities.

A U.S. maker of RTP equipment and International SEMATECH, the consortium of 13 chip makers, are evaluating the NIST test wafer in their own production and test equipment.

During trial runs, chipmakers use test wafers to relate wafer temperatures to RTP chamber temperatures, which are recorded by a light pipe radiation thermometer, or LPRT. Inserted through the bottom of the chamber, the LPRT tracks the temperature during actual production. With current methods, LPRTs can be calibrated with an uncertainty of 5 °C to 6 °C. The 1999 Technology Roadmap for Semiconductors set the goal of reducing measurement uncertainty to 2 °C.

NIST's response to the challenge included substituting on-wafer, thin-film thermocouples for the wire ones now used to measure the temperature at different points on the surface. The thin-film approach eliminates the large junctions where pairs of thermocouple wires meet, avoiding the measurement-complicating heat transfer that occurs at these points. In addition, the NIST team developed methods for calibrating their thin-film thermocouples on the international temperature scale, achieving an uncertainty of about 0.3 °C. In turn, LPRTs now can be calibrated on the scale, to within 2 °C.

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MEASUREMENT GAPS MAY "UNDERCHARGE" DEREGULATION BENEFITS

The deregulation of the electric power industry promises to bring lower prices and other benefits of competition to consumers. However, a recent economic study conducted for NIST shows that a lack of sophisticated measurement techniques and other technical obstacles could deprive Americans of as much as $6.5 billion annually of the deregulation benefits.

For example, the study states that as the number of companies involved in generating, transporting and delivering electricity grows, the number and complexity of transactions involved in those processes are expected to skyrocket. Such a highly distributed generation network requires advanced measurements of system parameters that efficiently send the data to control functions to ensure system reliability and security. So, while virtually every home and business has a meter that measures electricity consumption, that information alone and in its present usage will not be enough to do the job in the future.

The growing number of companies in the market also will increase the need for precise information about energy transactions. More precise measurements of standard billing parameters will be needed (e.g., energy, demand) to support contract management.

NIST plans to use the study to identify areas where its work on measurements and standards can have the greatest impact on maximizing the benefits of wholesale and retail deregulation of the American power industry.

For more information on the study "Changing Measurement and Standards Needs in a Deregulated Electric Utility Industry" (NIST Planning Report 00-2), contact Gregory Tassey, (301) 975-2663, tassey@nist.gov. To download an Adobe Acrobat copy from the World Wide Web, go to www.nist.gov/director/planning/strategicplanning.htm. A single print copy may be requested by contacting Denise Herbert, (301) 975-2657, denise.herbert@nist.gov.
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COMMERCIALIZATION OF NIST-DEVELOPED FORTRAN GRAPHICS STANDARD

f90gl, the FORTRAN interface for OpenGL graphics, is now emerging in commercial products. Private companies are including precompiled f90gl libraries with their LF95 FORTRAN compilers, and have included f90gl in their graphics product. Several other compiler vendors feature f90gl prominently on their web pages and plan to include f90gl in future releases of their FORTRAN compilers.

OpenGL is a standard three-dimensional graphics library available on most current computer systems. Developed by NIST, f90gl is a public-domain implementation of the FORTRAN 90 bindings for OpenGL, which also were developed by NIST and adopted by the OpenGL Architecture Review Board. f90gl runs on most Unix and Windows computers.

Although the source code for f90gl has been placed in the public domain, many compiler vendors have found that their customers prefer the convenience of precompiled libraries.

Further information on f90gl is available at math.nist.gov/f90gl.

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NIST-DEVELOPED PROCESS USED IN GMR MANUFACTURING

The present generation of computer hard-disk drives uses a read-head based on giant magnetoresistance (GMR) thin films. The manufacturing process used in these systems incorporates key improvements developed at NIST's Magnetic Engineering Research Facility (MERF). Research at MERF demonstrated that two key measures of the quality of GMR thin films could be improved significantly if the films were made using a very small quantity of oxygen as a surfactant during film growth to suppress alloying at interfaces in the film and to produce smoother film growth. This approach changes two of the critical properties of the films: it produces an increase in the GMR value and a decrease in the magnetostatic coupling. Engineers at a private company have reproduced the MERF results and have now incorporated these advances into their state-of-the-art manufacturing systems.

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NIST'S CRYPTOGRAPHIC MODULE VALIDATION PROGRAM VALIDATES 100TH CRYPTOGRAPHIC MODULE

On June 22, 2000, the Cryptographic Module Validation Program (CMVP) of the U.S. and Canadian governments achieved a significant milestone by issuing the programs 100th certificate. The module was validated successfully as meeting the Level 2 security requirements of Federal Information Processing Standard (FIPS) 140-1, *Security Require-ments for Cryptographic Modules.* The module provides network security by encrypting/decrypting all network traffic from/to the module when placed between the user Local Area Network and the external network.

The FIPS 140-1 Cryptographic Module Validation List has become a "Who's Who" of cryptographic and information technology vendors and developers from the United States, Canada, and abroad. The list contains a complete range of security levels and a broad spectrum of product types including secure radios, Internet browsers, VPN devices, PC Postage equipment, cryptographic accelerators, secure tokens, smart cards, and others. The recent validations impact federal agencies by further increasing the number and types of tested and validated cryptographic products available for use in securing sensitive information.

The CMVP is a joint effort between NIST and the Communications Security Establishment (CSE) of the Government of Canada. NIST and CSE serve as validation authorities for the program. The web site is csrc.nist.gov/cryptval.

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EDGE DETECTION AND IMAGE ANALYSIS SOFTWARE PROVIDES NEW INSIGHT TO OVERLAY METROLOGY

New image recognition and quantitative image analysis software has been developed by a NIST researcher for the Overlay Metrology Project. This comprehensive software package is based on the Matlab programming language and tool set and allows the evaluation of numerous effects on algorithm performance. This package has been used to quantify feature roughness and asymmetry effects on overlay pattern evaluation used in the feedback and control of lithography stepper tools. The package also has been used in the quantification of algorithm robustness for sample to noise effects. This

code has been used extensively to evaluate and compare several cross-correlation, self-correlation, and new least-squares correlation methods, which are proving to be the most robust edge detection and feature centerline determination methods.
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SUCCESSFUL KICKOFF OF NATIONAL COMPARISON OF MASS STANDARDS

The National Comparison of Mass Standards piloted by NIST began in June 2000. This comparison involves the states' Weights and Measures Laboratories and Puerto Rico. Six sets of mass standards each consisting of 10 kg, two 1 kg, 200 g, 100 g, 20 g, 2 g, 500 mg, and 10 mg stainless steel weights have been characterized fully by NIST and are currently in circulation. When the comparison is completed in March 2001, it will provide, for the first time, a formal, simultaneous, and systematic tie of the whole U.S. legal metrology system for mass to the national standard of mass and a direct leverage of the technical expertise of NIST. This intercomparison will impact around 300 000 mass measurements a year, guarantee the uniformity of these measurements across the United States, ensure equity in national trade, and provide uniform support of U.S. industry.
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NIST DIGITAL VIDEO 1 NOW PUBLICLY AVAILABLE

NIST researchers have collected several video clips in a single collection called NIST Digital Video 1. This is a public-domain collection of digital video created to encourage more researchers to address real-world problems and support the scientific comparison of solutions in digital video search, retrieval, and display. The collection consists of eight videos, totaling over two hours in length, selected from NISTs public domain archive of marketing, technical, and educational material. The characteristics of these videos include, but are not limited to, different levels of motion (static to fast-moving objects), close-up figures (talking heads, moving arms, and moving hands), outdoor shots (laboratory, auditorium, and conference room environments), and various levels and quality of audio. In addition to the base data, pre- or post-production transcripts are included as reference data.

Digital Video 1 was made publicly available on the web in April 2000. For more information on the videos and on ordering the DVD-ROM, see www.nist.gov/srd/nistsd26.htm.
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NIST DEVELOPS AN INFORMATION RETRIEVAL FRAMEWORK

NIST scientists have developed an Information Retrieval Framework (IRF), which is a freely available, object-oriented framework for information retrieval (IR) applications. The framework is software that defines the architecture of a group of related applications and supplies many of the basic components from which they can be built, allowing application developers to extend the basic components to meet their special needs. It is coded entirely in Java and includes a very simple text IR application, support for file-based persistence, and two small text document collections. As is, IRF and the sample application are suitable for experimentation on small text collections, although the framework was designed with multimedia IR in mind.

IRF was made publicly available on the web in July 2000. For more information on IRF and instructions for downloading the IRF package, see www-nlpir.nist. gov/projects/irf/irf.html.
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NEW NEUTRON SPECTROMETER COMMISSIONED AT NCNR

The first experiment, a study of the molecular dynamics of alpha-lactalbumin, has recently been performed on the disk chopper time-of-flight spectrometer (DCS) at the NIST Center for Neutron Research (NCNR). This instrument, which provides U.S. researchers access to world-class capabilities in the vital area of cold neutron spectroscopy, allows scientists to study dynamical processes in materials on time scales of less than 100 ps. As such it complements the neutron spin echo and backscattering spectrometers at the NCNR, which probe longer time scales, and another recently commissioned spectrometer, which probes shorter ones. During the commissioning phase the DCS, the worlds most flexible instrument of its type, has demonstrated state-of-the-art sensitivity. This combination allows researchers unprecedented ability to tailor the instrumental conditions to the physical processes of interest. Thus, the DCS is a unique tool, allowing measurements in important areas of research such as bio-processes, energy storage, glassy dynamics, chemical separation, and catalysis.

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NIST AND SI2 DEMO SOFTWARE FOR INTERNET-BASED QUICKVC IP EXCHANGE AT DAC

NIST staff, along with the Silicon Integration Initiative (SI2), demonstrated a new software tool NIST helped to develop at the Design Automation Conference (DAC) 2000 in Los Angeles, Calif. The QuickVC (Virtual Component) IP (Intellectual Property) Exchange is a reference implementation of the QuickVC specification being developed as part of the Electronic Component Information Exchange (ECIX) suite of protocols for the Electronics Industry. QuickVC will enable companies designing complex electronic products to readily find and use existing blocks of design from a broader range of sources and thus reduce time-to-market.

The QuickVC Program, underway since November 1999, has created working implementations for Internet-based query and response interfaces between VC providers, VC catalog providers, and their end users. Future goals of this program include release of formal QuickVC specifications. The content architecture of the ECIX QuickVC Specifications is designed to enable a query to be composed using a few common search criteria (QuickVC Elements). A standard response message structure is specified that is a prescriptive set of common information (also QuickVC Elements) and allows for additional content in the response (Extended QuickVC Elements).

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IMPROVED NIST WIDEBAND SAMPLING VOLTMETER TO CHARACTERIZE FAST PULSES

The NIST wideband sampling voltmeter is a precision equivalent-time waveform digitizing instrument for making accurate measurements of repetitive signals ranging in frequency from 10 Hz to 200 MHz. A previous version is used to determine the settling characteristics of fast pulse generators but is not capable of characterizing their transition- duration (i.e., rise-time). When designing and testing high-speed circuits, such as those using 1 GHz microprocessors, one of the most difficult tasks is to verify that the high-speed signals all arrive consistently at the proper time. An accurate measurement of pulse transition- duration is crucial to verifying such circuit operation.

An improved, gated-oscillator type of time-base has now been developed for the voltmeter that overcomes the limitations of the earlier design. Besides having an impressive basic performance, its timing linearity is improved even further with the use of a unique built-in hardware correction circuit and auto-calibration software scheme. The use of the auto-correction software scheme allows correction of the time base linearity so that the already low 1.5 ps rms timing jitter predominates, as contrasted to the best commercial digital oscilloscopes with linearity errors of 8 ps or greater. Consequently, the measurement of repetitive, short transition-duration (<100 ps) voltage steps is now possible for determining the waveform parameters of precision step generators. The details of this design have been described in a recent paper by NIST scientists entitled, "Improved Time-Base for Waveform Parameter Estimation" given at the Instrumentation and Measurement Technology Conference 2000 held in Baltimore last May.

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IMPROVED OPTICAL FIBER POWER MEASUREMENT SERVICES AT NIST

The optical fiber power measurement services provided by NIST have recently undergone substantial enhancement to better support the needs of the optical telecommunications industry and other users of optical fiber power meters. Absolute responsivity calibrations of optical fiber power meters are now offered by NIST at the following fixed nominal wavelengths: 670 nm, 780 nm, 850 nm, 980 nm, 1300 nm, and 1550 nm using any of the following connector types: FC/PC, FC/APC, ST, SC, E2000, SMA, and biconic. For special applications, tunable lasers are used to provide calibrations over limited wavelength ranges around 850 nm, 1300 nm, and 1550 nm as well. Measurement traceability for these calibrations now stems from a laser-optimized, cryogenic radiometer primary standard developed by NIST, and has enabled a reduction in measurement uncertainty to 0.5 % or less for typical absolute power calibrations. Linearity measurement services at 850 nm, 1300 nm, and 1550 nm also have been added to the calibrations offered for optical fiber power meters. The linearity measurements are performed using a NIST-developed, fiber and shutter system to implement a "triplet superposition" method of establishing detector response as a function of incident optical power. Formal internal NIST reviews of both the absolute power and the power linearity measurement systems recently were completed to assure that the highest possible quality and

accuracy was being provided in these measurement services.
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NEW MEASUREMENT SERVICES FOR RELATIVE INTENSITY NOISE (RIN) OF LASERS

The demand for greater bandwidth in optical fiber communications has led to the development of laser transmitters and optical amplifiers with very low noise. The noise of a transmitter is often specified by its relative intensity noise, or RIN. Because RIN can have a frequency dependence, the acronym RIN is used to denote the spectral density of the relative intensity noise. To meet industry demands for precise measurement of RIN, a NIST scientist has developed a transfer standard for calibrating RIN measurement systems that employ electrical spectrum analyzers to resolve the spectral density of the RIN.

The transfer standard is an erbium-doped fiber amplifier to which is coupled a linear polarizer and a narrowband optical filter (<5 nm) centered in the 1550 nm wavelength range. The device is characterized for frequencies between 0.1 GHz and 1.1 GHz. The spectral density of the RIN, however, is stable and relatively constant to several tens of gigahertz, rendering it suitable for calibrations at even greater bandwidths. The RIN of the transfer standard is nominally –110 dB/Hz, with an uncertainty of ≤0.12 dB/Hz. The invariance of the RIN under attenuation yields considerable dynamic range with respect to radio-frequency (rf) noise levels, and allows for the use of optical fiber connectors. The RIN of the transfer standard has been verified by a combination of theory and measurement, but it also has been confirmed using a laboratory RIN measurement system and a second RIN reference source.

This new measurement service recently has been reviewed and certified as a formal calibration service as well as a measurement assurance program (MAP). Customers are offered the choice of using the transfer standard to calibrate their own RIN system (a MAP), or they can send their own device to NIST for calibration. As an extension of this measurement service, the NIST scientist is developing a method for calibrating systems that measure the noise figure of optical amplifiers.
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DETAILED SIMULATION OF SINGLE ELECTRON PUMP SUGGESTS A PATH TO FEWER ERRORS

A NIST researcher recently completed a theoretical analysis of errors in a seven-junction electron pump in the presence of a source of high-frequency photons. The electron pump is a critical component of the new SET-based capacitance standard being developed and detailed modeling of the error mechanisms is a critical step to understanding and improving the performance of the pump. High-frequency photons, generated by charge noise in the substrate, are believed to be the most likely reason for the anomalously high (though still extremely rare) error rate in the pump currently used in the prototype SET capacitance standard. By scrutinizing the results of his calculation, which are quite complex due to the presence of photon-assisted tunneling processes, the NIST researcher has identified two processes that dominate the error rate. Since these error mechanisms are very sensitive to the applied gate voltages during a small fraction of the pumping cycle, it may be possible to suppress them by making a slight modification to the gate voltage sequence. The NIST researcher also has found that the next most likely error process in the simulation is some 100 times less likely than the dominant two. If the error rate in actual pumps is due to these same processes, this suggests that performance could be improved by making a specific change to the gate voltage sequence. A new version of the gate voltage control electronics is currently being designed to test this idea.
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SEMICONDUCTOR CHARACTERIZATION AND METROLOGY CONFERENCE AT NIST

The 2000 International Conference on Characterization and Metrology for Ultra Large Scale Integration (ULSI) Technology was hosted by NIST in June 2000. The conference is the third in a series; the first was held at NIST in 1995 and the second in 1998. The 2000 conference was highly successful, bringing in more than 220 attendees from the United States, the Netherlands, Belgium, France, Spain, Germany, Switzerland, Israel, Korea, China, Japan, and Taiwan. Forty invited talks were presented, nearly 100 poster papers were displayed, and a panel was hosted to summarize key issues emerging from the conference.

Under NIST leadership, the conference was organized to provide extensive coverage of metrology and characterization methods. Perspectives on industrial metrology requirements were highlighted as well as a review of the 1999 International Technology Roadmap for Semiconductors as a benchmark for characterization and metrology needs. Topics for the conference included challenges, front-end processing, contamination and defect analysis, lithography, interconnect and back-end processing, thin films, and critical analytical techniques.

The conference proceedings will be available in the spring of 2001. Orders may be placed on-line at www.aip. org/catalog/cpreq_form.html. Additionally, many of the talks will be made available for viewing on the conference web site at www.eeel.nist.gov/812/ conference, as well as an ongoing dialogue about issues posed by the panel.

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NIST FIRE RESEARCH RESOURCES FOR DISTANCE LEARNING FEATURED AT NATIONAL FIRE ACADEMY HIGHER EDUCATION CONFERENCE

In June 2000, *Fire on the Web* was demonstrated for more than 100 attendees at the Second Annual Fire & Emergency Services Higher Education conference held at the National Fire Academy in Emmitsburg, MD. Conference attendees included educators from over 65 different universities, colleges, community colleges, and state fire academies. The purpose of the conference was to begin development of a standardized fire science degree curriculum. *Fire on the Web* provides educators and students with access to a number of valuable NIST resources for distance learning programs. These include 60 000 references to the fire literature, experimental fire data, and fire models. NISTIR 6510, which is a compact disc (CD) based report of a fire recreation, also was displayed at the conference. This CD includes the computer-generated color animations of model simulations as well as the full text of the report. A video tape that featured three flashover scenarios was utilized to demonstrate the type of fire experiments conducted at NIST for which information is available.

NISTs presentation was taped for later broadcast over EENet, a broadcast network operated by the U.S. Fire Academy to provide state-of-the-art learning-at-a-distance programs to fire departments via satellite.

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INFORMATION TECHNOLOGY FOR ENGINEERING & MANUFACTURING (ITEM 2000) CONFERENCE

NIST hosted the ITEM 2000 conference in June 2000, at NIST. Experts from industry and NIST were featured in six sessions and panel discussions designed to examine integration and interoperability problems facing manufacturers as they deploy information technology products to increase productivity, to decrease time-to-market, to lower supply chain costs, and to expand their global reach. Session topics included product data management, manufacturing simulation, knowledge-aided engineering, process representation, electronic commerce, and eXtensible Markup Language (XML) for systems integration. Samples of questions addressed in the panel discussions are:

- What are the impediments to integration?
- What interfaces are appropriate and in what context?
- What standards are applicable?
- What integration approaches work?
- What applications need to interoperate with each other in order to improve business activities?
- What are the issues looming ahead?

For more information, see www.mel.nist.gov/div826/ msid/sima/item2000/item2000.htm

CONTACT: James Fowler, (301) 975-3180; james. fowler@nist.gov.

NIST ADDRESSES NEED FOR SECURITY METRICS

In June 2000, NIST and the Computer System Security and Privacy Advisory Board convened a workshop to discuss security metrics, the means by which IT security programs are measured. Focusing on unclassified systems, the workshop surveyed current information infrastructure protection metrics and their uses to identify any voids and suggest solutions. Security metrics are needed to understand the current state of program security, to improve that state, and to obtain resources and sponsorship for those improvements. The problem is the diversity of meanings given to security metrics and the ambiguity surrounding them.

The workshop provided a starting point to catalog and develop measures for determining the effectiveness of federal security programs. Workshop presentations are available at csrc.nist.gov/csspab/june13-15/sec-metrics. html.

CONTACT: Fran Nielsen, (301) 975-3669; fran.nielsen @nist.gov.

NIST SPONSORS 2000 NIST SPEAKER RECOGNITION EVALUATION WORKSHOP

NIST organized and hosted the 2000 NIST Speaker Recognition Evaluation Workshop in June 2000, in Linthicum, MD. The purpose of the workshop was to review performance of systems in the evaluation, to discuss trends in text-independent speaker recognition, and to plan the next evaluation. The participating and contributing sites were from industry, academia, and governments in Australia, France, India, Israel, South Africa, Spain, and the United States.

For the past 5 years, NIST has organized evaluations of text-independent speaker recognition performance on conversational telephone speech. The tasks included one-speaker detection, two-speaker detection, speaker tracking, and speaker segmentation. The 2000 evaluation included for the first time some data in Castilian Spanish and other non-English languages. These evaluations are open to all interested sites. A workshop is held following each evaluation for participants to review evaluation performance and the state of speaker recognition technology and to consider plans for future evaluations. These evaluations have become internationally recognized as the leading measure of state-of-the-art performance in text-independent speaker recognition.

CONTACT: Alvin Martin, (301) 975-3169; alvin.martin@nist.gov.

NIST HOSTS XSL CONFORMANCE TESTING MEETING

NIST hosted the first XSL Conformance Technical Committee meeting in June 2000, at NIST. XSL (Extensible Stylesheet Language) is a W3C recommendation (www.w3c.org/TR/XSL) for expressing stylesheets, which enables the transformation and formatting of XML data. Simply stated, XSL specifies the format into which XML data should be transformed (i.e., reformatted). Uses of XSL include transformation of XML into HTML for viewing in a browser or XML as input to another process (e.g., invoicing, accounts payable or receivable), database system, or device (e.g., WML or wireless, VoXML for speech to text). Since the number of XSL processors is on the rise, the need for conformance and interoperability increases.

The committee is developing a test suite for XSL processors, which will focus on two key areas. The first area is XSLT (XSL Transformation), which deals with applying a set of stylesheet transformation rules to the data and transforming the data into another document. The second area is XPath (XML Path Language), which provides a common syntax and semantics for the functionally shared by XSL transformations and XPointer (XML Pointer language). This version of the test suite will not include the formatting objects part of XSL. NIST also is developing a test suite harness to facilitate the delivery, presentation, and execution of the XSLT/XPath test suite. Currently, there are approximately 1500 tests. The final test suite will be completed by March 2001.

CONTACT: Carmelo Montanez-Rivera, (301) 975-2874; carmelo.montanes-rivera@nist.gov.

INTERNATIONAL STANDARDS ACTIVITY IN POLYMER MASS SPECTROMETRY

NIST will lead a new technical working area in quantitative mass spectroscopy of synthetic polymers recently formed under the auspices of VAMAS, the Versailles Project on Advanced Materials and Standards. The objective is to develop mass spectrometry as a quantitative, standard method to determine the molecular mass distribution of synthetic polymers. With recent advances in mass spectrometry it is possible to measure the molecular mass of some biological and synthetic polymers. Among the advances is a variation of time-of-flight mass spectrometry, MALDI ToF MS, in which laser ablation is used to produce charged polymers in the vapor state. This technique has the potential to be an absolute method for measuring the molecular mass distribution (MMD) of synthetic polymers, a long sought after goal in polymer characterization owing to its impact on polymer processing and macroscopic properties. Comparisons of mass distributions measured by MALDI ToF MS with moments of the mass distribution determined by existing methods reveal discrepancies that must be resolve if the mass spectrometry is to be accepted as a standard method. The VAMAS activity brings together leading laboratories in Japan, Germany, Italy, Canada, and the United States in a collaborative research project that will develop the test protocols and establish the systematic measurement uncertainties of the MALDI ToF MS method. A standard method for determination of the mass distribution of synthetic polymers is an anticipated output.

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READ ALL ABOUT IT! CONFERENCE TO SHOWCASE E-BOOKS

Electronic books have made history during the past year as titles from major authors became overnight sensations on the Internet.

The industry has matured a great deal since NIST sponsored the world's first e-book conference in 1998.

This year's conference included sessions on topics ranging from new e-book technologies to emerging

business models such as print-on-demand. An author's forum discussed the changing roles of writers, agents and publishers resulting from the rising popularity of e-books.

Other sessions covered topics such as international e-book activities, secure ways to transmit e-books, industry hardware and software standards, and accessibility for the blind. NIST presented the latest version of a prototype Braille reader that can transform e-book text into Braille.

This year's conference also included a public exhibit of the latest e-book products.

The Electronic Book 2000 Conference and Show took place in September 2000, in Washington, DC. The conference was co-sponsored by NIST and the National Information Standards Organization.

Media Contact: Philip Bulman (301) 975-5661; philip.bulman@nist.gov.

NEW VAMAS GROUP SEEKS MEASUREMENT SPECIFICATIONS FOR CERAMIC POWDERS

A new technical working area on characterization methods for ceramic powders and porous materials has been formed within the Versailles Project on Advanced Materials and Standards (known by the acronym VAMAS) to develop technical data on the size distribution and surface area of particles and porosity of unfired (green) bodies for use by standards-writing organizations. Standardized characterization methods can lead to improved performance and higher reliability of materials such as advanced ceramics by eliminating chemical impurities and irregularly shaped or sized particles during raw materials processing and the intermediate stages of ceramic manufacturing.

The group's activity will focus on prestandardization research and round-robin trials of test methods in three areaspowder properties, suspension characteristics and characterization of porous ceramics such as green bodies. The first project—started in October 2000—will develop the technical data for a standard for porosity measurements.

VAMAS was conceived in 1982 following an economic summit in Versailles, France. Canada, France, Germany, Italy, Japan, the United Kingdom, the United States and the European Community are partners in the effort. It supports trade in high-technology products through international collaborative research that leads to codes of practice and specifications for advanced materials. The research embraces all aspects of science and technology related to advanced materials required as a precursor to the drafting of standards—materials technology, test methods, design methods and materials databases.

Representing the public and private sectors, U.S. members of the new technical working area include NIST, other government laboratories, universities and ceramic companies. International representatives come from Germany, Japan and Sweden.

For more information about the new technical working area, contact Vice Chairman Said Jahanmir, (301) 975-3671, said.jahanmir@nist.gov.

Media Contact: Pamela A. Houghtaling (301) 975-5745; pamela.houghtaling@nist.gov.

NEW PAPER EXPLAINS CALIBRATION SERVICE FOR EXCIMER LASERS

Last year, NIST announced it had developed a new service to calibrate argon-fluoride excimer lasers for power and energy (go to the *NIST Update* archives under "News" on the NIST World Wide Web site—www.nist.gov—and click on the Oct. 12, 1999, issue). ArF lasers, which produce pulsed, ultraviolet radiation at a wavelength of 193 nanometers, are commonly used to correct vision impairments. These corneal sculpting techniques are known as photorefractive keratectomy and *in situ* keratomileusis (PRK and LASIK respectively). The lasers also are used in the computer industry for high-resolution photolithography to manufacture faster microprocessors and larger memory chips. A new technical paper from NIST goes into detail on the design of the 193 nm primary standard, complete with schematics and graphs. At the present time, NIST is the only national laboratory in the world to offer excimer laser power and energy calibration services.

To obtain a copy of paper no. 36, "Calibration Service for Excimer Lasers," contact Sarabeth Harris, NIST, MC 104, Boulder, CO 80305-3328; (303) 497-3237; sarabeth@boulder.nist.gov.

Media Contact: Fred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

INTERNATIONAL AGREEMENT KEEPS PARTNERS TRUE TO THEIR MISSION

MISSION—an international research project to develop and test "modeling and simulation environments for design, planning and operation of globally distributed enterprises"—moved a step closer to success when the three participating regions recently signed their first cooperative agreement.

Approved by the Intelligent Manufacturing Systems (IMS) Program in 1998, MISSION involves partners from the United States, Japan and the European Union in the building of the software equivalent of a docking station, a generic modeling platform with interfaces that link and integrate distributed models and user-selected

simulation tools, such as those for evaluating production scenarios. The platform will support simulations over a range of vantage points, from individual factories to entire supply chains. A distributed supply chain prototype is being built to demonstrate the generic platform.

Under the new pact, the MISSION partners have agreed that any intellectual property created during the course of work will be placed into the public domain. Signing for the United States along with NIST—the regional coordinator of the U.S. team—were seven major U.S. simulation software vendors, two companies, five universities and the Department of Defense's Defense Modeling and Simulation Office.

The IMS Program was initiated by Japan to foster international cooperation on manufacturing research and development. Twenty projects are currently under way, involving over 250 companies and more than 200 research institutes from Australia, Canada, the European Union, Japan and the United States.

U.S. companies interested in participating in MISSION should contact NIST's Swee Leong, (301) 975-5426, swee.leong@nist.gov. The terms of reference for participating in IMS projects are available at the IMS site on the World Wide Web at www.ims.org. Media Contact: Michael E. Newman (301) 975-3025; michael.newman@nist.gov.

NEW PUBLICATION DISCUSSES COMPUTER TECHNOLOGY IN WELDING

Persons interested in the use of computer technology in welding will want to get a new publication from NIST.

Included in *Ninth International Conference on Computer Technology in Welding* are 39 printed manuscripts that were submitted to the conference held in September 1999 in Detroit. The papers are divided into two tracksmodeling and weld sensing/control. Under modeling, there are papers on simulation of resistance welding, simulation of gas metal arc welding, weld shape and distortion modeling, solidification/weld composition modeling, general modeling and welding documentation. Under weld sensing and control, there are papers on monitoring of gas metal arc quality, gas metal arc droplet control, weld process automation, communication and interfaces, and database applications.

The visuals from two tutorials at the conference also are included in the document. These are developing an effective web page and networking of welding applications. The proceedings also contains an appendix with the names and addresses of all the speakers and attendees at the conference.

Copies of *Ninth International Conference on Computer Technology in Welding* (NIST Special Publication 949) are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Use GPO stock number 003-003-03649-8. Media ContactNFred McGehan (303) 497-3246; mcgehan@boulder.nist.gov.

NIST, ROBOTICS INDUSTRY SEEK A MORE "OPEN" RELATIONSHIP

While the term "open architecture" may make most of us think of a blueprint for a retractable-roof baseball sta-dium, it actually refers to an information technology system (software, hardware or a combination of both) that can be connected easily to devices and programs made by other manufacturers. Open architectures use off-the-shelf components and conform to approved standards.

For the robotics industry, the interoperability permitted by open architecture controls is considered critical to reducing the price of integrating different robotics systems. Lack of these controls is a major contributor to the $2 billion to $4 billion that U.S. industry spends annually on integrating robots into manufacturing systems.

To begin addressing the issue of open architecture controls for robotics, NIST and the Robotics Industries Association organized a workshop in February 2000. More than 50 participants from the three key sectors of the robotics market—system integrators, vendors and end users—attended and formed a working group. Recommendations for short-term actions were made, including providing a roadmap for the group, looking at current open architecture control standards (such as those for machine tools) from the perspective of robotics, establishing initial guidelines for data integration in factory networks, and creating a World Wide Web site with a glossary, references and related links (www.isd.mel.nist.gov/projects/openarch/).

In June 2000, the group met for the second time and better refined its definition of open architecture controls for robotics with two new concepts. The first concept split robot controllers into a proprietary part and an open (typically PC-based) part. The second identified three classes of external interfaces to the open part of a robot controller which would be proper areas for standardization factory data integration, peripheral integration and graphical display. Group members agreed to focus initially on factory data integration, proposing "first-wave standards" for such areas as media and protocols, information presentation, time synchronization and network management.

For the robotics open architecture control group's third meeting—in November 2000, preceding the 2000 Robotics Industry Forum in Orlando, Fla.—organizers sought field experiences with the proposed first-wave standards (to develop case studies) and proposals for using remote collaboration tools to refine the guidelines. Reports were submitted to the electronic mail list, openarch@nist.gov.

For more information, contact Frederick Proctor, (301) 975-3425, frederick.proctor@nist.gov.
Media Contact: Michael E. Newman (301) 975-3025; michael.newman@nist.gov.

PROPOSALS SOUGHT FOR PRECISION MEASUREMENT GRANTS

NIST is seeking project proposals for two research grants for fiscal year 2002 in the field of precision measurement and fundamental constants. NIST Precision Measurement Grants are awarded each year to faculty members of U.S. universities or colleges for work in determining improved values of the fundamental constants, investigating related physical phenomena or developing new, fundamental measurement methods. Each Precision Measurement Grant of $50 000 for 1 year may be renewed by NIST for up to two additional years for a total of $150 000.

Prospective candidates must submit summaries of their proposed projects and biographical information to NIST by Feb. 1, 2001. The application should include a pre-proposal summary of not more than five double-spaced pages outlining the objective, motivation and technical approach of the research and the amount and source of current funding for the research. This summary should be accompanied by a concise biographical sketch of the applicant and a list of the applicant's most important publications.

On the basis of this material, four to eight semifinalists will be selected by the NIST Precision Measurement Grants Committee and the Outside Review Committee to submit more detailed proposals.

Submit 10 copies of the pre-proposal summary to Peter Mohr, NIST, 100 Bureau Dr., Stop 8401, Gaithersburg, MD 20899-8401. For more information, contact Mohr at (301) 975-3217 or mohr@nist.gov, or visit the Precision Measurement Grants World Wide Web page at http//physics.nist.gov/ResOpp/ grants/grants.html.
Media Contact: Michael Baum (301) 975-2763; michael.baum@nist.gov.

SOFTWARE EVALUATION EXPEDITES INCREDIBLE SHRINKING OF TRANSISTORS

Somehow, a name like Silicon Dioxide Valley simply would not have the same catchiness as Silicon Valley. But people who work on semiconductors know that silicon alone is not enough to keep the computer revolution going.

Chip makers grow or deposit ultrathin films of silicon dioxide on silicon surfaces to give the electronic chips their desired functionality. Many semiconductor companies have developed their own methodology and modeling software to measure the thickness of these films. This is an important step in the race to make ever smaller microcircuits, because the oxide layer thickness must be reduced proportionately. In a modern manufacturing facility, the oxide may be only 2 nanometers thick—about the space of six atoms stacked end to end.

Engineers have learned that standard techniques of thickness measurement do not work reliably for such extremely thin layers. So, they are developing computer models to help identify where the current methodologies fail. Most of the difficulty occurs because films prepared at atomic dimensions become entangled in quantum phenomena, which must be taken into account to understand the way electrons behave in tiny circuits.

NIST scientists are championing a comprehensive study to compare quantum mechanical simulators and software suites designed to predict the properties of ultrathin silicon dioxide and alternate gate dielectric films. Despite the importance of such models and software, no comparative investigations of the differences between them have been reported. NIST's effort marks the first attempt at an objective evaluation.

Based on software suites available from a variety of university and corporate research groups, NIST researchers identified the relevant strengths and weaknesses of each model. These were presented to the SEMATECH Gate Stack Engineering Working Group and the International Metrology Council during the past year.

The demonstrations drew strong interest from the audience and ultimately prompted the developer of one simulator to modify its software. Since then, a private company has supplied ultrathin films for laboratory measurements at NIST and an evaluation for the second phase of benchmarking, which is now under way. Additional researchers have requested that their simulators be included in this expanded evaluation.

For more information, contact Curt A. Richter, (301) 975-2082, curt.richter@nist.gov.
Media Contact: Philip Bulman (301) 975-5661; philip.bulman@nist.gov.

NIST, GERMAN COUNTERPART TEAM TO DEVELOP REFERENCE MATERIALS

NIST and its German counterpart, Bundesanstalt Für Materialforschung und-Prüfung (also known as BAM), have agreed to work together on the development of reference materials. This collaboration is aimed at the global harmonization of material measurements through worldwide distribution of these reference materials.

Developed by NIST, standard reference materials are used for the calibration of scientific and technical instruments and for quality control of manufacturing processes and products. BAM develops the same types of materials, referred to as certified reference materials, for use in Germany.

Under the agreement, a joint research and development plan will be developed and approved by both NIST and BAM for each reference material. The first two reference materials planned for joint development are a ceramic powder with a high surface area and a ceramic porosity standard, which will complement ceramic reference materials already available from NIST and BAM.

For more information about the new agreement, contact Said Jahanmir, (301) 975-3671; said.jahanmir@nist.gov.

Media Contact: Pamela A. Houghtaling (301) 975-5745; pamela.houghtaling@nist.gov.

NIST FORM-BASED HANDPRINT RECOGNITION SYSTEM

NIST has been distributing public-domain handprint recognition software since 1994. Release 2 of the NIST Form-Based Handprint Recognition System was made available in 1997, and since that time, over 700 copies have been shipped all around the world.

In July 2000, a new release (2.1) was made available. This includes updated and more robust numerical methods used to perform eigenvector-based feature extraction and additional compilation scripts that support GNU "gcc" and "gmake" (www.gnu.org) and are targeted, but not limited, to the Linux operating system (www.linux.org). This release also may be compiled to run on computers running the family of Win32 operating systems by first installing the Cygwin library and associated port of GNU tools (sourceware.cygnus.com/cygwin).

NIST announced this new release to previous software recipients on July 7, 2000, and within 1 week, nearly 100 requests were received, with half from U.S.-based industry and universities and half international. After 6 years, interest in this NIST software remains high. It is available free of charge on CD by e-mailing a letter of request to mgarris@nist.gov.

CONTACT: Michael Garris, (301) 975-2928; mgarris@nist.gov.

NIST DEVELOPS MEASUREMENT TECHNIQUES TO VALIDATE PERFORMANCE OF HIGH-PRECISION OPTICAL CURRENT TRANSFORMER (OCT)

The use of OCTs by the electric power industry is growing as deregulation requires the industry to install increasing numbers of bulk metering equipment. OCTs are advantageous because of their lower price and significantly reduced insulation requirements in high voltage applications. Companies have begun production of OCTs that may possess metering quality uncertainties and stabilities. However, the performance of these devices needed to be documented in order for further development of this promising technology to occur.

In response to this need, NIST agreed to test a prototype OCT device manufactured by a private company. To perform the test, NIST personnel developed new digital calibration techniques to establish OCT uncertainties, linearity, and stability. These new measurement techniques complement the precision analog techniques used at NIST for conventional current transformer calibrations. The collaboration provided important performance information critical to its development plan and allowed NIST the opportunity to develop the testing procedures that will be required by the electric power industry in the future.

CONTACT: James K. Olthoff, (301) 975-2431; james.olthoff@nist.gov.

NIST EVALUATES RADIATION ACCIDENT BIODOSIMETRY

NIST will assist in validating a dosimetric study of a large-scale radiation accident in the former Soviet Union. This study aims to better define the health effects of radiation exposure.

From 1949 to 1956, the first Russian industrial nuclear facility, Mayak, poured about 7.6×10^7 m^3 of liquid radioactive waste with total activity of 10^{17} Bq (2.7×10^6 Ci) into the Techa river. The ^{90}Sr contribution to the total activity was 11.6 %. Among all radionuclides released from anthropogenic sources, ^{90}Sr provides one of the most significant health hazards to humans. The residents of the villages along the Techa river were exposed to both external irradiation (from

contaminated river water, sediments, flood-plane soils) and internal irradiation due to ingestion of radionuclides from dietary intake.

The most critical unknown in the Techa river dose reconstruction data is the external dose contribution. The only reliable method of reconstructing the external component to the total dose is electron paramagnetic resonance (EPR) spectrometry of teeth. The EPR method can reconstruct the total (internal plus external) radiation dose accumulated in dental tissues. This information is then combined with knowledge of the internal component in order to separate the external dose contribution on an individual basis. Dental tissues from members of this population have been archived and will be sent to NIST for analysis by EPR spectrometry. The NIST study should provide an independent source of data that can be used to validate this large-scale epidemiological study. These data also will be used to validate current radiation protection standards and practices.

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NIST-DOE CALIBRATION COOPERATION LOWERS UNCERTAINTY FOR STEP GAGE CALIBRATION

A NIST scientist, and the staff of the Department of Energy (DOE) Oak Ridge Metrology Center have analyzed 5 years of measurements of their check standards and customer step gages and revised the error budget for the calibration. The uncertainty is length dependent, but as an example—for a full meter, the uncertainty is 0.4 μm, a significant reduction from the previous 0.7 μm. The reduction is primarily due to a number of small process improvements. The new uncertainty is available on most one-dimensional calibrations up to 1.5 m.

CONTACT: Ted Doiron, (301) 975-3472; theodore.doiron@nist.gov.

NIST ANNOUNCES ACCREDITATION OF FOUR NIAP COMMON CRITERIA TESTING LABORATORIES (CCTLs) FOR IT SECURITY TESTING

Under the auspices of the National Information Assurance Partnership (NIAP), NIST and the National Security Agency announced the approval of the first four accredited IT security testing laboratories under the Common Criteria Evaluation and Validation Scheme (CCEVS). The laboratories successfully completed the rigorous National Voluntary Laboratory Accreditation Program (NVLAP) process and have been accredited to conduct evaluations of commercial-off-the-shelf (COTS) products against the Common Criteria for Information Technology Security Evaluation (ISO/IEC15408). The process included an in-depth analysis of each laboratory's quality system and procedures, the administration of a comprehensive proficiency test covering the application of the Common Criteria and the Common Evaluation Methodology, and an on-site assessment of the laboratory facilities. These CCTLs are the first in a series of commercial organizations that are undergoing NVLAP accreditation for participation in the NIAP CCEVS.

The evaluation results produced by these CCTLs and validated by the NIAP CCEVS Validation Body will be recognized by 12 other countries currently participating with the United States in the Common Criteria Recognition Arrangement signed during the 1st International Common Criteria Conference earlier this year. In order for the Validation Body to issue an internationally recognized certificate, the evaluation must have been conducted by a third party, independent laboratory in accordance with the requirements of the NIAP. The web site is http://csrc.nist.gov/cc/.

CONTACT: Arnold Johnson, (301) 975-3247; l.johnson@nist.gov.

NIST PUBLISHES SEVENTH EDITION OF NATIONAL TYPE EVALUATION PROGRAM PUBLICATION

NIST has published the seventh edition of National Conference on Weights and Measures Publication 14, *National Type Evaluation Program Technical Policy, Checklists, and Test Procedures.* Since 1984 NIST has administered the National Type Evaluation Program (NTEP) in cooperation with the National Conference on Weights and Measures (NCWM), industry, and the states. NTEP tests commercial weighing and measuring devices to determine their compliance with the requirements in NIST Handbook 44, *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.* Many states require that commercial weighing and measuring devices have NTEP Certificates of Conformance.

The seventh edition incorporates the changes that have been made to NIST Handbook 44 and to the type evaluation checklists over the last 2 years. The checklists in Publication 14 document the criteria used by NTEP laboratories to verify the compliance of weighing and measuring devices with legal metrology requirements.

Manufacturers of the devices use the checklists to design their devices to comply with requirements, thereby reducing design costs and decreasing the time required to get the products to the market.
CONTACT: Henry Oppermann, (301) 975-5507; henry.oppermann@nist.gov.

NIST NOMINATES CONFORMITY ASSESSMENT BODIES (CABs)

In July 2000, NIST nominated 22 testing laboratories to the Canadian government to serve as CABs. All of the nominees have been accepted and confirmed by Industry Canada (IC). These CABs will provide test data responding to Canadian requirements under the terms of Phase I of the Asia Pacific Economic Cooperation (APEC) Mutual Recognition Arrangement (MRA) on Telecommunica-tions Equipment. The test data produced by these bodies will be accepted by IC and used in the product approval process for telecommunications products tested under Canadian Standard CS-03. OSS is preparing to nominate CABs to several other APEC nations.

NIST also is preparing dossiers for a group of CABs to be nominated to the European Commission as final designations under the electromagnetic compatibility (EMC) and Telecommunications Sectors of the U.S.-European Union (EU) MRA. Thirty-nine potential CABs are being evaluated for the EMC sector and 26 in the telecommunications sector. Designated bodies will be able to assist U.S. manufacturers to select proper test suites for applicable products and/or review and evaluate Technical Construction Files on covered equipment exported to the EU.
CONTACT: Robert Gladhill, (301) 975-4273; robert.gladhill@nist.gov.

POTENTIAL ANTI-CANCER AGENT INVESTIGATED AT NIST

NIST researchers are investigating liposome-encapsulated, alpha-emitting radionuclides for potential use in combating liver cancer. The American Cancer Society estimates that there are about 15 300 new cases of liver cancer each year in the United States, with a mortality rate of 90 %. One of the difficulties in treating this disease is the small number of treatment modalities available to physicians. The most widely used treatment schemes, for example, irradiation with external beams, have the disadvantage of exposing healthy liver tissue in the vicinity of the tumors to high radiation fields causing damage to one of the bodys most fragile organs. An alternative approach being investigated by the Radioactivity Group uses radionuclides such as ^{211}At, ^{212}Bi, and ^{213}Bi that emit alpha particles. Alpha particles deposit a much higher amount of energy over a very short distance (2 to 3 cell diameters), thereby killing the tumor cells while sparing healthy liver tissue.

The method being pursued involves encapsulating these radionuclides with liposomes, which are spherical lipid vesicles that can mimic cellular membranes. Because lipids tend to be taken up by the liver, liposomes are an attractive candidate as a potential delivery mechanism for these radionuclides. Using a protocol previously developed for the encapsulation of the imaging nuclide ^{99m}Tc, the researchers have successfully encapsulated ^{211}At using cyclotron-produced material from NIH in Bethesda. Further studies will focus on development of a quantitative analysis procedure, along with characterization of in vitro stability and radiosensitivity. Long-term plans include expansion of the studies to other alpha-emitting radionuclides, such as the aforementioned ^{212}Bi and ^{213}Bi.
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NIST MEASURES AN OPTICAL FREQUENCY IN A SINGLE MERCURY ION

NIST staff members recently have reduced the uncertainty in the measurement of the 282 nm optical-clock transition of a single positive mercury ion by a factor of 1000. This transition and optical transitions in other ions are extremely promising as primary frequency standards because their systematic frequency shifts can be exceedingly small (as low as 10^{-18}) and their Q values (frequency divided by linewidth) are enormous. The Boulder group recently measured a Q exceeding 10^{14}.

The measurement was made relative to a known optical transition in calcium using a new femtosecond-laser frequency comb. The comb concept, developed at the Max Planck Institute in Germany, provides a large set of equally spaced frequencies that can be used, almost like a ruler, to make measurements of very large frequency differences, in this case a difference of 76 THz. The uncertainty of the new measurement is limited not by the measurement method but rather by the uncertainty of $\pm$120 Hz for the calcium frequency, which was measured by another German laboratory using conventional frequency-synthesis methods. The next step in measurement of the transition will be to extend the frequency range of the comb to allow direct frequency measurement relative to the primary cesium frequency standard, which operates in the microwave region. CONTACT: James Bergquist, (301) 975-5459; bergquist@boulder.nist.gov or Leo Hollberg, (301) 975-5770; hollberg@boulder.nist.gov.

NIST PIONEERS THE USE OF IMAGE PLATES FOR FAR UV SPECTROSCOPY

NIST scientists have demonstrated the effectiveness of photostimulable image plates for recording spectra in the far ultraviolet region (5 nm to 60 nm) of the electromagnetic spectrum. Although image plates have been used for higher energy applications, such as x-ray crystallography, no one previously had attempted to use them for far UV spectroscopy. Based on the NIST results, image plates eventually may replace the expensive, hard-to-handle, and often hard-to-get photographic plates usually used to record spectra at these wavelengths.

Image plates are film-like sheets coated with a rare earth phosphor such as BaBrF:Eu. When exposed to energetic radiation, electron-hole traps are created in the phosphor that can persist for very long periods of time, even weeks. When illuminated with a red laser, the traps decay by fluorescing in the blue. If an image plate that has been exposed to high energy radiation is scanned with a laser in a special reader, a two-dimensional map of the exposed region is created in a computer, where software developed for this application can be used to process the data. The image plate then can be erased and reused. Furthermore, image plates have a response that is linear over a wide dynamic range. By using spark sources with the NIST 10.7 m grazing-incidence spectrographs, the NIST researchers successfully recorded spectra in the 5 nm to 60 nm region with image plates, with sensitivity that was comparable to that of photographic emulsions made for this spectral region. These results were published recently in *Applied Optics*. Further work to develop this technique in cooperation with industry is anticipated.

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DAMAGE OF SEMICONDUCTOR DETECTORS BY 157 nm EXCIMER IRRADIATION STUDIED BY NIST SCIENTISTS

Researchers at NIST have evaluated the stability of semiconductor diodes under irradiation from an excimer laser operating at 157 nm. This study provides important information about the mechanism responsible for the degradation of photodiodes and also for the suitability for use of various kinds of detectors for different applications such as semiconductor lithography, medical purposes, and micromachining.

To perform this study, the scientists built a facility at SURF III that allows simultaneous exposure of photodiodes to excimer radiation and synchrotron radiation. The photodiodes are expose to intense, pulsed laser radiation for varying times, while the low intensity radiation from the synchrotron source is used to characterize the photodiodes. Changes in the spectral responsivity of different kinds of diodes, such as UV silicon, GaP, GaAsP, PtSi, diamond, and GaN, were measured for a large range of the total accumulated dose from an F_2 excimer laser operating at 157 nm. These measurements can be made in the spectral range from 120 nm to 320 nm with a standard uncertainty of 0.5 %.

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STABLE VACUUM ULTRAVIOLET IRRADIANCE METER DEVELOPED BY NIST

NIST scientists have constructed and characterized a probe that is suitable for making accurate measurements of irradiance in the vacuum ultraviolet spectral region. Many industrial applications such as semiconductor chip fabrication, photo-lithography, and UV curing, require accurate measurement of the irradiance and will benefit from having a stable, accurate UV probe. In the past, the ability to measure irradiance accurately has been limited by the stabil-ity of detectors at short wavelengths.

The probe consists of a PtSi detector behind a precision 5 mm aperture, and was characterized at various wavelengths ranging from 157 nm to 325 nm using synchrotron radiation from SURF III. This range encompasses many of the important wavelengths for industrial applications. The principle of measurement is based on scanning the probe through a UV light field and measuring the spectral responsivity at regular intervals. Measurement of the spectral responsivity in the center along with the integrated total responsivity yields the spectral irradiance. Alternatively, this method can be used to calculate aperture areas by measuring the ratio of the total responsivity and the responsivity at the aperture center.

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NIST MEASURES THE DUV RESPONSIVITY OF GaN AND AlGaN PHOTODIODES FOR SOLAR-BLIND DETECTORS

NIST researchers, in collaboration with colleagues from private industry, and the University of Minnesota, recently have measured the deep ultraviolet (DUV) responsivity of GaN and AlGaN photodiodes for use as solar-blind photodetectors. A solar-blind photo-detector

has high sensitivity to ultraviolet radiation, but no appreciable response to visible radiation. These devices are important tools in many scientific and industrial applications in which one wants to measure ultraviolet light in the presence of high intensity visible light; for example, observing solar ultraviolet intensity in environmental monitoring systems, and measuring the wafer plane dose in deep ultraviolet lithography processes. Presently, however, simple, solar-blind detectors are not available.

The measurements were made from the infrared to the DUV portion of the electromagnetic spectrum (1500 nm to 116 nm). In spite of the relatively large band gap exhibited by these materials, the visible-light rejection ratio of the photodiodes remains far short of that needed for most applications. The observed response to visible light of the detectors can be accounted for by modeling the effect of line dislocation defects in the detectors crystal structure. The defects create regions of high electric field strength, the existence of which enables photoresponse in the visible spectrum. Both materials are known to be highly susceptible to such defects, and the researchers are developing techniques to reduce the defect density by a factor of 200, which will increase the visible-light rejection ratio to 10^6.

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NIST MEASURES THE ELASTIC PROPERTIES OF THIN FILMS WITH ULTRASOUND

Surface coatings are used throughout industry to give ordinary materials extraordinary resistance to wear and corrosion as well as to provide specialized electrical or magnetic properties for device applications. Knowledge of the elastic properties of the coating is important not only for estimating the residual thermal stresses but also for ensuring that the desired microstructure is present. During the past 2 years, an ultrasonic technique has been developed in which lasers are used to launch and detect surface waves that propagate along the coated surface of a thick substrate. Because the transducers use optical interactions with the substrate and the film, they are non-contacting in nature and can operate at frequencies extending up to hundreds of megahertz. This allows the surface wave velocity to be measured with high accuracy at wavelengths extending down to tens of microns. Theoretical models that relate the elastic constants of the film and substrate to the surface wave velocity are available in the seismology and surface acoustic wave device literature but they are cumbersome for deducing the film properties from measurements of the surface wave velocity.

NIST has advanced the technology both experimentally and theoretically by dealing with elastically anisotropic materials at frequencies approaching 500 MHz and by developing a Greens function formalism that speeds up and simplifies the deduction of elastic properties from surface wave velocity measurements. These new capabilities recently have been used in a cooperative program with an Australian laboratory to measure the elastic properties of a series of submicron thick TiN films deposited on silicon single crystal wafers. These films were of particular interest because they were elastically anisotropic and supported a range of residual stresses.

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NCNR PUTS INTO OPERATION NEW PERFECT CRYSTAL DIFFRACTOMETER FOR ULTRA-HIGH RESOLUTION SANS

A perfect crystal diffractometer (PCD) for ultra-high resolution small-angle neutron scattering (USANS) measurements is now operational at NIST's Center for Neutron Research (NCNR). The PCD increases the maximum size of features accessible with the NCNR's 30 m long, pinhole collimation SANS instruments by nearly two orders of magnitude, from $\approx 10^2$ nm to 10^4 nm.

The PCD is a Bonse-Hart-type instrument with large triple-bounce, channel-cut silicon (220) crystals as monochromator and analyzer. The perfect crystals provide high angular resolution while the multiple reflections suppress the "wings" of the beam profile, improving the signal-to-noise ratio to values comparable to that obtained with pinhole instruments. This technique, widely utilized for x rays for many years, only recently has been adapted successfully for neutrons, as dynamical diffraction effects arising from the deep penetration of neutrons in thick perfect crystals have become understood. The design of the NCNRs PCD successfully eliminates these undesirable effects, resulting in a signal-to-noise ratio of 105 at a minimum scattering vector $Q = 0.0004$ nm^{-1}. The performance of the NIST instrument is either superior or comparable to that of any USANS instrument currently in operation worldwide.

The measurement range of the PCD overlaps that of the NCNR's 30 m SANS instruments. Together they probe structure in materials over four orders of magnitude, from ≈ 1 nm to 10^4 nm. Combined measurements

on these instruments will enable hierarchical and highly anisotropic microstructures in materials, for example, in fiber or clay impregnated nanocomposites, to be more fully characterized. The PCD is part of the NIST/NSF Center for High Resolution Neutron Scattering (CHRNS) with up to two-thirds of the available beam time to be allocated by the NCNR's Program Advisory Committee to scientists and engineers who submit proposals for peer review.

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NIST DEVELOPS TOOL FOR UNDERSTANDING ROLES OF ADDITIVES IN SUPERCONFORMAL ELECTRODEPOSITION OF COPPER

A multidisciplinary effort is under way at NIST to develop an understanding of superconformal electrodeposition of copper, which recently has been implemented for on chip interconnects. Future demands for high density of interconnects with very short signal delay times require interconnects that are very narrow and have a high electrical conductivity. Superconformal deposition, which is promoted by the presence of small concentrations of additives in the electrolyte, enables the copper to deposit without voids into vias and trenches having high aspect ratios.

Recently NIST researchers have demonstrated superconformal electrodeposition of copper in 500 nm deep trenches ranging from 500 nm to 90 nm in width using an acid cupric sulfate electrolyte containing chloride (Cl), polyethylene glycol (PEG), and 3-mercapto-1-propanesulfonate (MPSA). The behavior of the system is representative of several commercial electrolytes and may be employed usefully as a model or "test bed" for exploring the "superfilling" phenomenon. In contrast, similar experiments using either an additive-free electrolyte, or an electrolyte containing the binary combination Cl-PEG, Cl-MPSA, or simply benzotriazole (BTAH), resulted in the formation of a continuous void within the center of the trench. Examination of the current-potential deposition characteristics of the electrolytes reveals an hysteretic response associated with the C1-PEG-MPSA electrolyte that can be employed usefully to monitor and explore additive efficacy and consumption. This provides an easily used tool for developing an understanding of the specific roles of the additives in promoting superfill.

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RANDOMNESS TESTS FOR RANDOM AND PSEUDORANDOM NUMBER GENERATORS USED IN CRYPTOGRAPHIC APPLICATIONS

NIST has developed a suite of 16 tests to check the randomness of binary sequences produced by random or pseudo-random number generators that may be used for many purposes, including cryptographic, modeling, and simulation applications. The focus is on those applications where randomness is required for cryptographic purposes, such as the generation of keying material. These tests are documented in NIST Special Publication (SP) 800-22, *A Statistical Test Suite for Random and Pseudorandom Number Generators for Cryptographic Applications.* The publication and associated tests are intended for individuals responsible for the testing and evaluation of random and pseudorandom number generators, including (P)RNG developers and testers. The document provides a high-level description and examples for each of the 16 tests, along with the mathematical background for each test. The statistical tests and SP 800-22 are available at http://csrc.nist.gov/rng/.

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NEW NIST LATENT FINGERPRINT DATABASE RELEASED

NIST, in conjunction with the FBI, has developed a new database of grayscale fingerprint images and corresponding minutiae data. NIST Special Database 27, "Fingerprint Minutiae from Latent and Matching Tenprint Images," contains latent fingerprints from crime scenes and their matching rolled fingerprint mates. The uniqueness of a fingerprint can be determined by the pattern of ridges and furrows as well as the minutiae points. The minutiae points are local ridge characteristics that occur either where a ridge divides into two or at a ridge ending.

The database has a total of 258 latent cases; each case includes the latent image, the matching tenprint image, and four sets of minutiae that have been validated by a professional team of latent examiners. One set of minutiae contains all minutiae points on the latent fingerprint; the second set contains all minutiae points on the tenprint mate; the other two sets contain the minutiae points in common between the latent fingerprint and tenprint mate. In all, there are 27 426 minutiae recorded across the set of tenprints with 5460 minutiae in common with their matching latent fingerprint. Software utilities are provided to read, write, and manipulate these files.

The database can be used to develop and test new fingerprint algorithms, test commercial and research Automated Fingerprint Identification Systems (AFIS), train latent examiners, and promote the ANSI/NIST file format standard. It is available on CD by ordering from the NIST Standard Reference Data web site. Examples from this database are located at the anonymous FTP site sequoyah.nist.gov at /pub/databases/data/sd27.tar. CONTACT: Michael Garris, (301) 975-2928; michael.garris@nist.gov.

INTERNET-ASSISTED REMOTE CALIBRATION DEMONSTRATED

NIST has demonstrated an Internet-assisted calibration of an electronic instrument located at the Sandia National Laboratories (SNL). This is the first example of a so-called "e-calibration" in the electrical area on a remote programmable instrument for a NIST customer. The instrument under test at SNL was a multifunction calibrator used to calibrate the five electrical measurement functions available on most digital multimeters (DMMs). The reference at NIST for this test was a commercial multifunction calibrator, which is periodically characterized using basic NIST electrical standard artifacts. Artifact calibration of commercial calibrators also is used at many industrial standards laboratories; however, even with automation, it takes a skilled metrologist about one week to perform the characterization. The objective of the new e-calibration service is to relieve NIST customers of this burden by performing an in situ calibration of their calibrator using a precision DMM, calibrated by the NIST-characterized multifunction calibrator, as a traveling transfer standard. The DMM and the calibrators are fully programmable, and the control software used to calibrate them implements a test set-up and the test parameters for each instrument. It is critical that the same test procedures are employed at both laboratories.

A password-accessible calibration report for the SNL calibrator was posted to evaluate the usefulness of electronic test reports. With further refinements, it is expected that this new calibration process will become a NIST Special Test next year.
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NIST WATT BALANCE LIVES

A NIST research team has reassembled the NIST watt balance experiment inside its newly decorated home and the reborn apparatus is showing the first signs of life. The upgraded facility includes vibration isolation, rf shielding, and, perhaps most importantly, a unique vacuum chamber made of fiberglass where the balance resides. The vacuum system has successfully achieved a pressure which is sufficiently low to virtually eliminate the largest uncertainty component in the previous version of the experiment. Heat dissipation of the main measurement coil and breakdown of the electrostatic actuators at this pressure have been investigated and do not pose a problem as initially feared.

Recently the researchers made some preliminary measurements, balancing the force of a 12 g mass in local gravity against an electromagnetic force produced by the auxiliary feedback coil and magnet. Best scatter to date is 5×10^{-5} g over a 3 minute measurement which translates to 5×10^{-8} of the 1 kg standard used in the experiment. Although just the first steps toward the ultimate goal of monitoring the drift of the artifact mass standard in terms of highly stable electrical units, these early results are very encouraging.
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NEW TECHNIQUE FOR A HIGHER VOLTAGE AC JOSEPHSON STANDARD

Achieving practical output voltages is one of the greatest challenges for the ac Josephson voltage standard, also known as the Josephson arbitrary waveform synthesizer. Researchers recently have demonstrated an ac coupling technique that increases the useful output voltage for metrology measurements. Metrology applications require direct coupling of the array voltage to the calibration instrument with no common mode voltage. 5.4 mV was the previous highest peak output voltage able to be used for metrology calibrations. The voltage was low because only small arrays of 250 junctions could be uniformly biased without a common mode voltage. In the ac coupled technique, NIST researchers have effectively removed the common mode signal by dividing the low and high frequency bias components and applying them to the array through different circuits. With this technique, arrays of 4096 junctions have been used to achieve more than a 10-fold increase in output voltage (64 mV peak) for a single array with no degradation in operating margins. This technique also has the potential for significantly higher output voltage by enabling multiple arrays to be connected in series. The first ac-dc voltage comparisons using this technique will be performed in the next few weeks.
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NEW OFF-SITE HIGH-POWER LASER CALIBRATION CAPABILITY

Multi-kilowatt high-power lasers are being used today for a wide variety of industrial applications, including materials processing, cutting, and welding. Although detectors used with these laser systems need measurement traceability, the high cost of the large and expensive lasers has limited NIST to providing calibration services at powers up to only 1 kW. Recently, however, a NIST scientist has developed, tested, and implemented the capability of performing off-site laser detector calibrations at powers up to 10 kW or more. Using a special transportable calibration system composed of various optical components, a characterized transfer standard, and a compact, stable water flow system, the customer's own high-power laser can be used as the radiation source for detector calibrations. In the first official use of this system, calibrations were performed for a U.S. manufacturer of high-power laser systems using their multi-kilowatt CO_2 laser source. This off-site measurement system significantly extends the NIST high-power laser measurement capability and will allow better support to the laser-based materials processing industry without forcing NIST to spend large amounts of money purchasing the necessary lasers.

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EDGE DETECTION AND IMAGE ANALYSIS SOFTWARE PROVIDES NEW INSIGHT TO OVERLAY METROLOGY

New image recognition and quantitative image analysis software has been developed by NIST for its Overlay Metrology Project. This comprehensive software package is based on the Matlab programming language and tool set and allows the evaluation of numerous effects on algorithm performance. This package has been used to quantify feature roughness and asymmetry effects on overlay pattern evaluation used in the feedback and control of lithography stepper tools. The package also has been used in the quantification of algorithm robustness for sample to noise effects. This code has been used extensively to evaluate and compare several cross-correlation, self-correlation, and new least-squares correlation methods that are proving to be the most robust edge detection and feature centerline determination methods.

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WORKSHOP HELD ON MOISTURE SENSORS FOR BUILDING ENVELOPES

A workshop to discuss moisture sensing in building envelopes was held at NIST in July 2000. Researchers and industry representatives met to discuss many of the problems that exist in determining the moisture content of building materials and to discuss new technologies that may improve those measurements. Moisture in homes and buildings lies at the heart of many problems that afflict buildings. Mold, pests, allergens, structural damage, and unwanted heat loss arise when unwanted water accumulates in the building envelope. While the modeling of moisture transport has advanced the state of knowledge in controlling these problems, the sensing technology for measuring the in-situ moisture content in building materials has lagged.

Several presenters with extensive field and laboratory experience shared their success and failures in measuring moisture. These presentations indicated that the technol-ogy is sorely in need of refinement to provide sensors with simpler installation, more accurate calibrations, and less drift. It also was determined that a need exists for both moisture content measurements in the building materials (for model verification and predictions of rot) and relative humidity measurements at the surface of the materials (as an indicator of mold and mildew growth). Several presentations were made on new technologies that potentially could be used for these applications such as infrared sensors, nuclear magnetic resonance, fiber optic sensors, and algorithms that can be incorporated in sensors to predict the onset of damage. Information from the workshop will enable NIST to target its research efforts on moisture sensors.

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SURF CONTINUES TO GROW

The Summer Undergraduate Research Fellowship (SURF) Program, had 52 students participating this year, an increase of 18 % over 1999. Twenty-nine institutes of higher education participated in 2000, compared to 21 in 1999.

The SURF programs at NIST are a part of the National Science Foundation's Research Experiences for Undergraduates program, and they provide NIST an active role in the training of future generations of scientists and engineers, with an emphasis on increasing the involvement of women and minorities in science, mathematics and engineering. A large majority of

SURF students pursue advanced degrees, with the remainder going to industry and teaching. The SURF program also contributes to the diversity of the pool of scientists and engineers from which NIST draws new talent.

The SURF program has developed long-term relationships with undergraduate institutions that have strong science, mathematics, and engineering programs; that emphasize undergraduate research as a training tool; and that serve minority groups. The three SURF programs have combined to mentor more than 200 students since 1993. The overall program continues to average approximately 50 % women, more than 30 % African-American and Hispanic, and has had Asian, Pacific Islander, and physically disabled students as well.

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NIST STAFF MEMBER CO-CHAIRS WORKING GROUP OF THE INTERNET ENGINEERING TASK FORCE

A NIST staff member recently was selected as co-chair of the Public Key Infrastructure Using X.509 (PKIX) Working Group of the Internet Engineering Task Force (IETF). The IETF is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. It is open to any interested individual. The IETF develops the protocols and standards needed to support the Internet. The actual technical work of the IETF is done in its working groups, which are organized by topic into several areas (e.g., routing, transport, security, etc.).

The PKIX Working Group was established in the fall of 1995 to develop Internet standards supporting an X.509-based public key infrastructure (PKI). Since its inception, the IETF has developed 11 standards refining and augmenting the X.509 certificate standard to meet the requirements for an Internet X.509 PKI. These standards include a profile of the X.509 version 3 certificates and version 2 certificate revocation lists (CRLs), protocols for issuing and revoking certificates, online certificate status mechanisms, protocols for retrieving certificates and CRLs from LDAP, FTP, and HTTP servers, and guidance for authors of certificate policies. These PKIX specifications are widely used by industry as the basis for product development.

PKIX is now focusing on additional standards work to develop protocols that are either integral to PKI management or that are otherwise closely related to PKI use. PKIX is defining conventions for certificate name forms and extension usage for "qualified certificates," certificates designed for use in (legally binding) non-repudiation contexts. A profile of the X.509 attribute certificate for Internet use is in development. Work is also under way on protocols for time stamping and data certification. These protocols are designed primarily to support non-repudiation, making use of certificates and CRLs, and are so tightly bound to PKI use that they warrant coverage under this working group.

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NIST WELL REPRESENTED AT THE ISO TC213 MEETING

Two NIST scientists represented NIST at the meeting of ISO Technical Committee (TC) 213 on Dimensional and Geometrical Product Specifications (GPS) and Verification and its component Working Groups (WGs), held in June 2000, in Berlin. This committee has a wide-ranging scope encompassing dimensional and geometrical tolerancing, surface properties, dimensional measuring equipment, and calibration requirements, including the uncertainty of dimensional and geometrical measurements. In these areas, the committee produces a large number of documentary standards that affect the practice of dimensional specification and measurement in the United States. One scientist attended as a U.S. expert for WG 5 on Calibration Procedures for Surface Texture. WG5 has completed its agenda and produced four Draft International Standards within 3 1/2 years. This scientist also reported to the Main Committee as the Liaison to TC 172 on Optics and Optical Instruments. The other NIST scientist convened WG 6 on General Requirements for GPS Measuring Equipment and reported to the Main Committee on the status of WG6 work. One WG6 document, ISO 14978, entitled "General Concepts and Requirements for GPS Measurement Equipment," will soon be released for a draft international standard ballot. A second document, ISO 463, dealing with the design and metrological characteristics of dial gauges, is now ready for a committee draft ballot. Both Vscientists also attended Working Group 14 on Vertical GPS Principles.

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BEST PAPER

Three NIST researchers received the Automatic Radio Frequency Techniques Group (ARFTG) Best Paper Award at the 55th ARFTG Conference held this past June. They were given this award for their paper "Equivalent Circuit Models for Coaxial OSLT Standards," which they presented at the 54th ARFTG Conference last December. Their paper provided an analysis of the common equivalent circuit models used to describe coaxial vector network analyzer (VNA) standards. Such models are used in commercial instruments but have never been described fully or tested in the open literature. The authors developed a model based on general network analysis techniques and compared it to the calibration of a commercial instrument. Verification-device data corrected using their methods agreed well with data corrected by a commercial VNA. By uncovering the basic equations of equivalent circuit descriptions, this work revealed the limitations users face when trying to adopt the common coaxial descriptions to lossy on-wafer standards. This paper also provided in one place all the equations necessary to perform Open-Short-Load-Thru calibrations for any standards, given either direct measurements or appropriate models for the transmission-line parameters and reflection coefficients

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NIST'S PADE FEATURED IN NEW BOOK ON BUILDING LINUX CLUSTERS

NIST's Parallel Application Development Environment (PADE), a tool for developing parallel applications on a computer network, is featured in the new book: *Building Linux Clusters,* published in July 2000, by O'Reilly and Associates (http://www.oreilly.com/catalog/clusterlinux/).

PADE was produced by NIST in 1995 (http://www.itl.nist.gov/div895/pade/), and provides a single graphical user interface that incorporates all essential tools for development of parallel applications on a homogeneous or heterogeneous computer network, using the Parallel Virtual Machine message-passing library.

Building Linux Clusters presents PADE as one of the most extensively used tools in the field, and provides a copy of the PADE software on its bundled CD-ROM. PADE has already had considerable success as a stand-alone program and is available on a NIST web server. Now it also will be distributed as part of an enterprise solution package by one of the leading publishers serving the Unix and Linux communities.

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NIST'S SOFTWARE USABILITY PROGRAM GAINING INDUSTRY ATTENTION

Recent articles in several publications highlighted two software usability products developed at NIST—NIST WebMetrics and the Common Industry Format (CIF) for Usability Test Reporting. This signifies industry understanding of the importance of these measurement tools for assessing web and software usability.

A product review of automated web usability tools included a favorable article about one of the NIST WebMetrics tools—the Web Static Analyzer Tool (WebSAT). This article was included in the August 2000 issue of *Web Techniques* (http://www.webtechniques.com/archives/2000/08/stratrevu/) and noted WebSAT's usefulness for ensuring that the HTML code follows good coding practices and for providing basic usability guidelines. WebSAT identifies potential usability problems according to six categories: accessibility, form use, performance, maintainability, navigation, and readability.

In addition, the recently released book *WebSite Usability Handbook* provides a CD that includes the NIST WebMetrics Suite. The suite includes four tools, which are also available on the web (http://www.nist.gov/webmet/).

The feature article in the July 2000 issue of the *Computer Systems Technical Groups CSTG Bulletin* explained the benefits of the Common Industry Format (CIF) for Usability Test Reporting project at NIST (http://wellhost.com/cstg/nl2000_27_1.pdf). This project was initiated 3 years ago at NIST to increase the visibility of software usability by means of a widely accepted and understood method for reporting the results of usability testing. Several prominent software suppliers and consumer organizations worked together to understand user needs and tasks and to develop a common format. This allows consumer organizations to treat usability as an important criterion for software procurement. The first release of the CIF is available on the web (http://zing.ncsl.nist.gov/iusr/documents/cifv1.1b.htm).

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